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Production and Labor Cost per Unit of Product

Rising Hourly Earnings Predominant in All Segments of Recent Cycles

If average hourly earnings were stable, labor cost would fluctuate in proportion to man-hours per unit of product. In the production phases and stage-to-stage segments for which we have data, the frequency of rises and declines in both would be the same. But wage rates often rise in expansions, and the percentage of time paid for at overtime rates also rises; both kinds of change, of course, tend to increase hourly earnings. In recent times, however, earnings have often risen in contractions also, although not as rapidly. We have computed three-month averages for hourly earnings, or indexes thereof, at peaks and troughs in production, similar to the average for man-hours per unit previously described. They increased in 88 per cent of the expansions and 86 per cent of the contractions. In general, therefore, the changes in hourly earnings tended to raise labor cost when production was rising, whereas the changes in hours per unit reduced it. When production was diminishing, on the other hand, both influences tended to raise labor cost.

We have also computed averages of hourly earnings for the various stages of the production cycles.[1] They show that rises in hourly earnings outnumbered declines not only over whole phases but also in every segment of expansion or contraction (Table 12). The frequency does not change with entire regularity from segment to segment, but rises were more numerous in the last half of expansion than in the first and in the first half of contraction than in the last.

[1] Both the three-month peak and trough averages and the others were computed by dividing the corresponding averages for labor cost per unit by those for man-hours per unit. Where the dividend and divisor are in the form of index numbers, the result is an index number of hourly earnings rather than a figure in dollars and cents.

TABLE 12

Average Hourly Earnings, Number of Changes from Stage to Stage of Production Cycles, Classified by Direction, Twenty-three Industries

From Stage	To Stage	Number of				Per Cent		
		Rises	Zero Changes	Falls	Observations	Rising	Unchanged	Falling
I	II	63	1	25	89	71	1	28
II	III	68	0	21	89	76	0	24
III	IV	77	2	10	89	87	2	11
IV	V	77	1	11	89	87	1	12
V	VI	84	1	12	97	87	1	12
VI	VII	86	0	11	97	89	0	11
VII	VIII	75	4	18	97	77	4	19
VIII	IX	65	1	31	97	67	1	32
I	V	79	0	11	90	88	0	12
V	IX	85	2	12	99	86	2	12

NOTE: Production workers only. Does not include social security, pensions, etc.

Cost Nevertheless Usually Falls When Production Rises and Vice Versa

When the influences of hours per unit (h/p) and hourly earnings (c/h) are opposed, as they often have been in expansions, the outcome depends on the comparative size of the changes in the two components. If h/p falls 10 per cent from one period to another, while c/h rises 15 per cent, cost per unit (c/p) in the second period will equal $.90 \times 1.15 \times c/p$ in the first period, or 1.035 times the initial c/p.

On the whole the changes in h/p have been more potent than those in c/h. On the basis of three-month averages for labor cost at production peaks and troughs, there were 34 rises and 56 declines in the 90 expansions, and in the 99 contractions there were 90 rises and 9 declines. Cost therefore fell in 62 per cent of the upswings and rose in 91 per cent of the downswings. In most instances it fluctuated inversely with output. The influence of the widely prevalent rises in c/h was not strong enough to prevent c/p, like h/p, from falling in a majority of expansions; but the majority was reduced.

These percentages for labor cost, of course, are from monthly figures. Calculations based on the most nearly corresponding annual data indicate declines in 51 per cent of the expansions, a very slight preponderance; and a greater amount of rises in contractions, in 68 per cent of which labor cost rose. Annual figures, obviously, tend to obscure the inverse relation between cost and production. In expansions, they understate the size of the upswing in volume and therefore minimize its tendency to reduce cost. In contractions, they minimize the severity of the decline and minimize its tendency to raise cost.

There are 152 expansions and 175 contractions of output in one industry or another for which we have only annual figures on production and labor cost per unit (Table 13). In spite of the blunting effect of annual figures, it is encouraging to note that they also suggest an inverse relation: cost declined in 57 per cent of the expansions, rose in 51 per cent of the contractions.

Our monthly labor-cost data, like the monthly man-hour data, pertain to production workers only. Even annual figures suggest that aggregate payments to other workers do not fluctuate as much as the payments underlying our measures of cost. The ratio of total wages and salaries in manufacturing to production worker payrolls increased in every contraction between 1929 and 1958. It declined in the first three expansions, but rose in the last two (Table 14). These rises, however, were less rapid than those in the neighboring contractions. It seems likely that if we had monthly figures for pay of all workers per unit of product, they would disclose a declining ratio in all contractions. Such changes in the ratio would mean that cost of non-production workers per unit of product must fluctuate inversely with production by even greater percentages than cost for people directly engaged in production. In any event, the fluctuation must be similar in direction.

The monthly data, and also the annual figures just discussed, do not include social security taxes, contributions to pension and welfare plans, or other "supplements to wages and salaries" that are costs to employers. They have increased in relative importance from 1.27 per cent of production worker payrolls in 1929 to fourteen per cent in 1958. The introduction of social security during the period, increases in the rates of tax, and changes in industrial pension and welfare policy obscure any cyclical characteristic that may have been present. It is worth noting, however, that the ratio to wages and salaries of all such payments declined substantially in the expansion of 1938-43 and slightly in that of 1946-48. The fraction of earnings subject to tax must have declined in these expansions. The tax did not apply to earnings in excess of $3,000 per year, and average weekly earnings in manufacturing rose from $22.30 in 1938 to $46.08 in 1944; therefore, an

TABLE 13

Direction of Change in Labor Cost per Unit of Product, Based on Annual Data for Which There Are No Corresponding Monthly Data

	Period Covered by Expansions and Contractions	Number of Expansions in Which Cost per Unit		Number of Contractions in Which Cost per Unit	
		Increased	Decreased	Increased	Decreased
Iron mining	1942-54	2	1	4	0
Copper mining	1943-53	2	0	2	0
Lead and zinc mining	1942-51	2	0	2	0
Anthracite coal	1923-33	1	0	1	1
Bituminous coal	1923-37	1	2	0	3
Meat	1921-32	0	3	2	1
Ice cream	1921-46	0	6	3	2
Canning and preserving	1927-57	4	3	6	2
Grain products	1920-47	3	5	4	3
Grain products and feed	1950-57	2	0	1	1
Bakery products	1924-39	2	0	1	1
Cane sugar	1920-39	2	2	3	2
Beet sugar	1940-48	2	0	3	0
Cane and beet sugar	1948-55	1	1	2	0
Confectionery	1926-38	0	2	0	3
Beverages	1948-54	1	1	2	1
Malt liquors	1940-47	2	0	1	0
Cigars	1929-38	0	1	0	2
Cigarettes	1930-32	0	0	0	1
Other tobacco	1923-39	3	1	2	2
Cotton	1921-32	0	3	0	3
Silk and rayon fabrics	1920-39	0	5	1	3
Wool	1920-32	1	4	2	3
Knit goods	1948-58	2	1	2	2
Floor coverings	1948-51	1	0	1	1
Lumber [a]	1921-38	2	2	1	2
Wood containers	1949-58	2	0	0	2
Furniture and fixtures	[b]	4	2	2	5
Paper	1920-32	0	2	1	2
Newspapers and periodicals	1920-38	1	2	3	1
Chemicals	1923-38	1	1	2	1
Organic chemicals	1948-58	1	2	2	2
Rayon and nylon yarn	1931-49	0	3	2	2
Paints and varnishes	[c]	2	3	3	3
Fertilizer	[d]	1	2	1	3

TABLE 13 (*Continued*)

Direction of Change in Labor Cost per Unit of Product, Based on Annual Data for Which There Are No Corresponding Monthly Data

	Period Covered by Expansions and Contractions	Number of Expansions in Which Cost per Unit		Number of Contractions in Which Cost per Unit	
		Increased	Decreased	Increased	Decreased
Petroleum refining	1929-38	1	0	0	2
Coke and products	1944-49	1	0	2	0
Tires and tubes	1928-32	0	0	0	1
Other rubber	1928-38	2	0	2	1
Leather	1921-39	1	3	1	2
Footwear [e]	1921-36	1	3	0	4
Glass	1920-38	1	3	2	3
Cement	1920-33	0	1	0	2
Structural clay	1920-58	4	4	5	4
Steel	1919-32	0	4	2	2
Nonferrous smelting and refining	[f]	2	1	2	1
Agricultural implements	[g]	2	3	6	1
Motor vehicles	1920-38	0	4	4	1
Railroads	1915-21	2	0	1	1
Total manufacturing		55	83	79	80
Total all industries		65	86	89	85

NOTE: Production workers only.
[a] Does not include one contraction in which there was no change in c/p.
[b] 1921-1938, 1948-1958.
[c] 1920-1938, 1949-1958.
[d] 1921-1938, 1953-1954.
[e] Does not include one expansion in which there was no change in c/p.
[f] 1927-1938, 1942-1947.
[g] 1923-1939, 1948-1958.

employee working all fifty-two weeks at the latter rate would have received $2,396. Such a figure stands near the middle of a range—many workers earn less, but many earn more. The percentage of workers earning over $3,000 must have been larger in the later year than in the earlier. If the rate of tax becomes stable in future cycles, and if the maximum taxable earnings (currently $4,800) are not too much above average annual earnings at the peak of production, one may expect the cost of governmental

TABLE 14

Ratio of All Manufacturing Wages and Salaries to Production Worker Payrolls at Peaks and Troughs in Manufacturing Production

Date of Peak or Trough	Level of Production	Years or Months from Preceding Date	Ratio	Change from Preceding Date		
				Total	Per Year or Month	
					To Peak from Trough	To Trough from Peak
		Years			*Per Year*	
1929	Peak	...	1.35	...	...	...
1932	Trough	3	1.52	.17	...	.057
1937	Peak	5	1.31	−.21	−.042	...
1938	Trough	1	1.37	.06	...	.060
1943	Peak	5	1.21	−.16	−.032	...
1946	Trough	3	1.32	.11	...	.037
1948	Peak	2	1.30	−.02	−.010	...
		Months			*Per Month*	
Feb. 1946	Trough	...	1.33	...	...	...
Oct. 1948	Peak	32	1.30	−.03	−.001	...
Nov. 1949	Trough	13	1.32	.02	...	.002
July 1953	Peak	44	1.35	.03	.001	...
July 1954	Trough	12	1.41	.06	...	.005
Aug. 1957	Peak	37	1.45	.04	.001	...
Apr. 1958	Trough	8	1.54	.09	...	.011

social security, per unit of product, to fall in expansions and rise in contractions. The information about private pension and welfare plans is at present inadequate for determining the relation of their cost to cycles in output.

Inverse Changes Again More Frequent at Beginning of Swings in Production

Our files contain a chart of labor cost for each of the twenty-three industries. On each chart the turning points in cost are marked by asterisks in the same way as the turning points in man-hours per unit on Chart 3, and the turning points in production are indicated by vertical lines. We can

therefore classify each phase of production according to the sequence of change in labor cost (Table 8, last two columns). Immediately after the trough, labor cost fell in most expansions, 61 of our 90. In 42 of the 61, the decline did not last, but turned into a rise that persisted to the end of the phase. Other sequences also ended in a rise, so that cost was going up just before the end in 71 of the 90 expansions.

Immediately after the peak, cost rose in 87 of the 99 contractions. Some of these rises turned into declines, some initial declines were sustained to the end, and still other sequences occurred. Whatever the intermediate course, cost was rising just before the trough in a majority of contractions, 57 of the 99. But the majority was smaller at the end than in the beginning.

Instead of looking at the charts, we can examine the frequency of rises and declines in cost during various portions of expansions and contractions with the aid of stage averages, as we did in the case of hours per unit. We have computed such averages of cost for each stage of each production cycle. Comparisons of successive stages are summarized in Table 15. The percentage of rises is very low in first segments of expansions, but increases steadily to 64 in the fourth segment.

TABLE 15

Labor Cost per Unit of Product, Number of Changes from Stage to Stage of Production Cycles, Classified by Direction, Twenty-three Industries

From Stage	To Stage	Rises	Zero Changes	Falls	Observations	Per Cent		
						Rising	Unchanged	Falling
I	II	13	0	76	89	15	0	85
II	III	33	0	56	89	37	0	63
III	IV	52	1	36	89	58	1	40
IV	V	57	2	30	89	64	2	34
V	VI	80	0	17	97	82	0	18
VI	VII	81	1	15	97	84	1	15
VII	VIII	74	1	22	97	76	1	23
VIII	IX	64	1	32	97	66	1	33
I[a]	V[a]	34	0	56	90	38	0	62
V[a]	IX[a]	90	0	9	99	91	0	9

NOTE: Derived from working tables for each industry and cycle of production. Production workers only. Does not include social security, pensions, etc.

[a] Based on three-month averages in all instances.

In contractions the upward progression is eventually, although not immediately reversed. After jumping from 64 in the last segment of expansion to 82 in the first segment of contraction, it continues its upward climb to 84 per cent in the second segment. But after that it diminishes, and the percentage of rises is only 66 in the last segment.

Rising Cost Predominant in Last Half of Expansion and All Segments of Contraction

Labor cost therefore resembles man-hours per unit in the sense that rises in both become more common as expansion proceeds and less common, at least in the later segments, in contraction. But in expansion, rises in hours per unit, although becoming more frequent, never outnumber declines. Rises in cost, on the other hand, do predominate in the third and especially in the last segment of expansion. Like rises in hours per unit, but more strongly, they dominate all segments of contraction.

Cost Rose More Often Than Man-Hours per Unit

Because of the upward pressure from average hourly earnings, present to some degree even in the contraction phases of recent cycles, labor cost has risen more frequently than man-hours per unit in expansions, in contractions, and in comparable portions of either. Hours per unit (h/p) had a net rise in 8 per cent and cost (c/p) in 38 per cent of the 90 expansions in production. H/p rose in 71 per cent of the contractions, c/p in 91 per cent. In expansions, rising c/p was more frequent than rising h/p just after the trough and just before the peak, in contractions, just after the peak and just before the trough (Table 8). Rises in c/p exceeded rises in h/p in all segments of expansion and contraction (Chart 4).

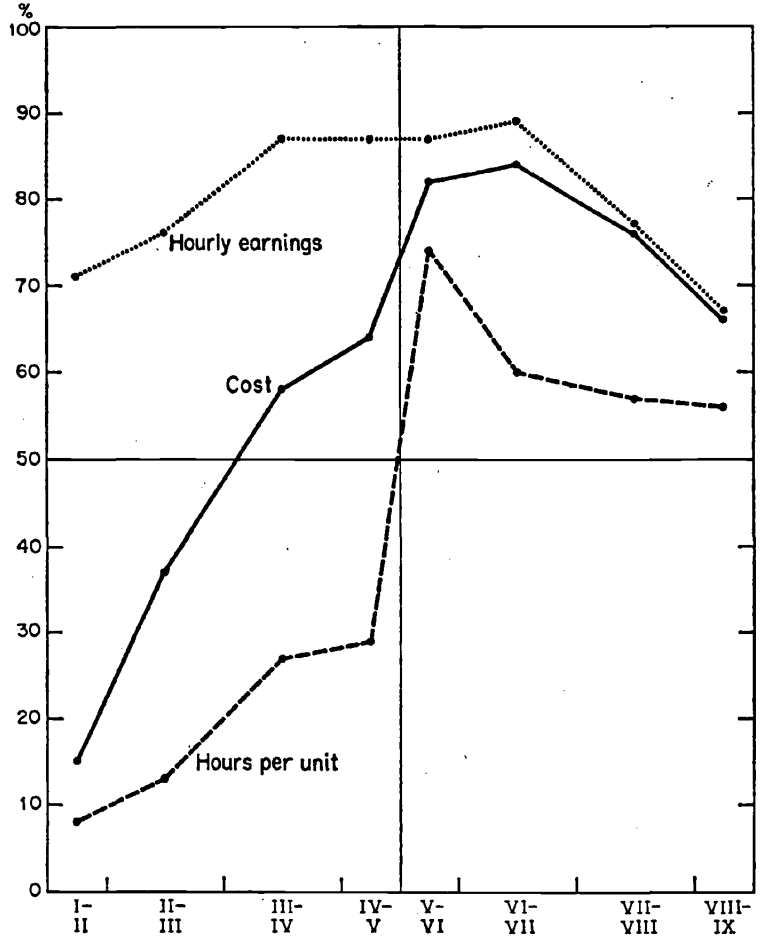
Of the characteristic net declines in cost during expansions, 45 were due entirely to declines in hours per unit, since hourly earnings c/h rose or did not change (Table 16, Stages I to V). Hourly earnings were a contributing factor in 11 more, but the sole factor in none. On the other hand, of the characteristic net rises in contraction, 59 reflected a rise both in h/p and c/h, 11 a rise in h/p only, and 20 a rise in c/h only. In all segments of both phases, rises in c/h alone were responsible for a substantial portion of rises in cost, while declines in c/h alone explain a negligible portion of declines in cost.

Fewer Industries with Inverse Relation for Cost Than for Hours per Unit

Since labor cost tends to rise more often than hours per unit in expansions, one would expect to find fewer industries with an inverse relation of c/p than of h/p to output. For some of the industries in which we found a high

CHART 4

Percentage Frequency of Rises in Hours per Unit, Average Hourly Earnings, and Labor Cost During Successive Segments of Production Cycles



From Tables 10, 12, and 15.

inverse relation between h/p and production we do not have a sufficiently long record of labor cost. But for twenty-six we have data for eight or more phases of production (Table 3). Only twelve of these, or less than half, had inverse scores numerically higher than -25, while twelve had negligible scores and two a positive score exceeding 25. In contrast, we found acceptably high inverse scores for h/p in twenty-three, or 68 per cent, of the thirty-four industries in which we could study this component of cost.

TABLE 16

Contributions of Components to Rises and Falls in Labor Cost During Production Cycles

From Stage	To Stage	Number of Rises in Labor Cost, Caused by			Number of Falls in Labor Cost, Caused by		
		Rise in Man-Hours per Unit Only [a]	Rise in Hourly Earnings Only [b]	Rise in Both	Fall in Man-Hours per Unit Only	Fall in Hourly Earnings Only	Fall in Both
I	II	1	6	6	52	0	24
II	III	0	22	11	35	2	19
III	IV	3	28	21	27	0	9
IV	V	2	31	24	21	0	9
V	VI	5	8	67	9	0	8
VI	VII	6	24	51	11	0	4
VII	VIII	15	20	39	16	1	5
VIII	IX	15	11	38	16	1	15
I	V	0	27	7	45	0	11
V	IX	11	20	59	6	0	3

[a] I.e., hourly earnings falling or unchanged.
[b] I.e., man-hours per unit falling or unchanged.

Inverse Relation Obscured in Statistical Aggregates

As in the case of hours per unit, we have made a composite index of cost per unit for fifteen manufacturing industries, beginning January 1947, in each of two ways. In Index I, aggregate payrolls in the fifteen combined are divided by their combined production. In Index II, cost in each industry is weighted by its 1947-49 Federal Reserve production weight.

If changes are measured between turning points in the composite production of the fifteen industries, Index I does not appear to show any cyclical relation to output (Table 17). It declined in two of the expansions, rose in the other; it fell in two contractions and rose in two. Index II, however, fell in all expansions of output and rose in all but one contraction. Even in that exceptional phase, the decline proceeded less rapidly than in the preceding or following expansion.

These computations ignore something we have often noticed in individual

TABLE 17

Composite Indexes of Labor Cost per Unit of Product at Turning Points in Composite Production, Fifteen Manufacturing Industries, 1948-58

Date of Peak or Trough	Level of Production	Months from Preceding Date	Cost Index I	Change in Index I			Cost Index II	Change in Index II		
				Total	Per Month			Total	Per Month	
					To Peak from Trough	To Trough from Peak			To Peak from Trough	To Trough from Peak
July 1948	Peak	...	102.0	...	...	...	102.3	...	...	...
Oct. 1949	Trough	15	98.5	−3.5	...	−0.23	103.0	0.7	...	0.05
Sept. 1950	Peak	11	96.8	−1.7	−0.15	...	97.1	−5.9	−0.54	...
July 1952	Trough	22	106.9	10.1	...	0.46	109.7	12.6	...	0.57
July 1953	Peak	12	107.3	0.4	0.03	...	107.1	−2.6	−0.22	...
July 1954	Trough	12	105.2	−2.1	...	−0.18	106.0	−1.1	...	−0.09
Nov. 1955	Peak	16	103.9	−1.3	−0.08	...	103.0	−3.0	−0.19	...
Apr. 1958	Trough	29	111.3	7.4	...	0.26	115.1	12.1	...	0.42

industries, namely, a tendency for a fall in cost to reverse itself before the end of an expansion in output, and for a rise to reverse itself before the end of a contraction. If we allow for this tendency, we find more evidence of an inverse relation in the aggregate. We can match each peak or trough in composite cost with a turn of the opposite character in output, although the process leaves some of the turning points in the latter without partners (Table 18). In every instance the turn in cost precedes the paired turn in

TABLE 18

Turning Points in Composite Production and Composite Labor Cost, Fifteen Manufacturing Industries, 1948-58

Production		Cost (Index I)			Cost (Index II)		
Date	Level	Date	Level	Lead (−) or Lag (+)	Date	Level	Lead (−) or Lag (+)
July 1948	Peak	...	...	...	...	...	...
Oct. 1949	Trough	May 1949	Peak	−5	May 1949	Peak	−5
Sept. 1950	Peak	Apr. 1950	Trough	−5	Apr. 1950	Trough	−5
July 1952	Trough	...	...	...	June 1952	Peak	−1
July 1953	Peak	...	...	...	...	...	...
July 1954	Trough	Dec. 1953	Peak	−7	...	...	...
Nov. 1955	Peak	Dec. 1954	Trough	−11	Mar. 1955	Trough	−8
Apr. 1958	Trough	Dec. 1957	Peak	−4	Apr. 1958	Peak	0

production, except in April 1958, when the peak in Cost Index II coincided with the trough in production.

Composite production probably had a trough in 1945 or 1946. In 1947, the year the data begin, we find cost rising and it continues to climb during the rest of the expansion and most of the following contraction. It is probable that cost had a sharp rise in this expansion as a whole. Hourly earnings increased so fast in this inflationary period that their influence doubtless overpowered the influence of increasing production.

Cost May Have Declined in Earlier Severe Contractions

Of the contractions for which we have annual but no monthly data, ten had peaks in 1920 and troughs in 1921, coinciding, as nearly as we can tell from yearly figures, with a major contraction in the economy at large. Thirty-seven ended in the years 1930-33, coinciding with or overlapping the 1929-32 contraction phase of the Great Depression. In both groups, average hourly earnings fell off in all but a few instances, and most of the

declines, according to the yearly figures, were accompanied by declines in labor cost (Table 19). The severity of the drop in production is minimized, of course, in these data, and it is possible that monthly data would show more frequent rises in labor cost. Nevertheless, it seems likely that declines may have preponderated in these earlier and severe business disturbances, in which wage rates were not immune to the impact of recession.

In contractions of output that corresponded to the milder business contractions of 1923-24 and 1926-27, on the other hand, and in those with peaks and troughs at miscellaneous dates between 1919 and 1929, rises in average hourly earnings were as numerous as, or more numerous than, declines, and rises in cost outnumbered declines, as they did in the contractions after 1933 (Table 20).

TABLE 19

Direction of Changes in Average Hourly Earnings (c/h) and Labor Cost per Unit of Product (c/p), Contractions in Production Ending in 1933 or Earlier

	1920-21		1923-24		1926-27		Great Depression				Other Dates			
	c/h	c/p	c/h	c/p	c/h	c/p	Peak	Trough	c/h	c/p	Peak	Trough	c/h	c/p
Anthracite							1926	1933	−	−	1923	1925	+	+
Bituminous			−	−			29	32	−	−	26	28	−	−
Meat					−	+	29	32	−	−	24	25	+	+
Ice cream			−	+			29	33	−	−	25	26	+	+
Canning and preserving							30	32	−	−				
Flour					−	−	28	32	−	−	24	25	+	+
Bakery products							29	33	−	−	24	25	+	+
Cane sugar	−	−									22	23	+	+
											26	28	−	+
Confectionery							29	32	−	−	26	28	+	−
Cigars							29	33	−	−				
Cigarettes							30	32	−	−				
Other tobacco							24	33	+	−				
Cotton			−	−			29	32	−	−	27	28	+	−
Wool			+	+			29	30	+	+	25	26	−	−
							31	32	−	−	27	28	−	−
Silk and rayon goods			+	−			29	30	−	−	25	26	+	+
							31	33	−	−				

Lumber			+	0			1929	1932	−	−	1925	1928	+	+
Furniture							29	32	−	−	27	28	+	−
Paper	−	−	+	+			29	32	−	−				
Newspapers and periodicals	+	+			−	+	29	33	−	−				
Paints	−	−					29	32	−	−				
Rayon yarn and fiber							31	32	−	−				
Chemicals			+	+			29	32	−	−				
Fertilizer					+	−	29	32	−	−				
Petroleum							29	32	+	−				
Tires and tubes							28	32	−	−				
Other rubber products							28	32	+	−				
Leather			+	+			27	32	−	−				
Footwear			+	−			29	30	−	−	27	28	−	−
							31	32	−	−				
Glass	−	−	+	+	−	−	28	32	−	−				
Cement	−	−					28	33	−	−				
Clay products	−	−	+	+			26	32	−	−				
Steel	−	−	+	+	+	+	29	32	−	−				
Nonferrous smelting and refining							29	32	−	−				
Agricultural implements			+	−	+	+	29	33	−	+				
Motor vehicles	−	−	−	+	+	+	29	32	−	+				
Railroads	−	−									18	19	+	+
Number +	1	1	11	9	4	5			4	3			12	10
Number of zero changes				1										
Number −	9	9	4	5	4	3			33	34			5	7

TABLE 20

Changes in Labor Cost During Contractions for Which There Are No Monthly Data

	Total Number	Number with Cost			Percentage with Cost		
		Rising	Unchanged	Falling	Rising	Unchanged	Falling
Contractions ending in 1921 or in 1930, 1931, 1932, or 1933	47	4	0	43	9	0	91
Contractions ending in other years before 1934	40	24	1	15	60	2	38
Contractions ending later than 1933	88	61	0	27	69	0	31
Total	175	89	1	85	51	1	49